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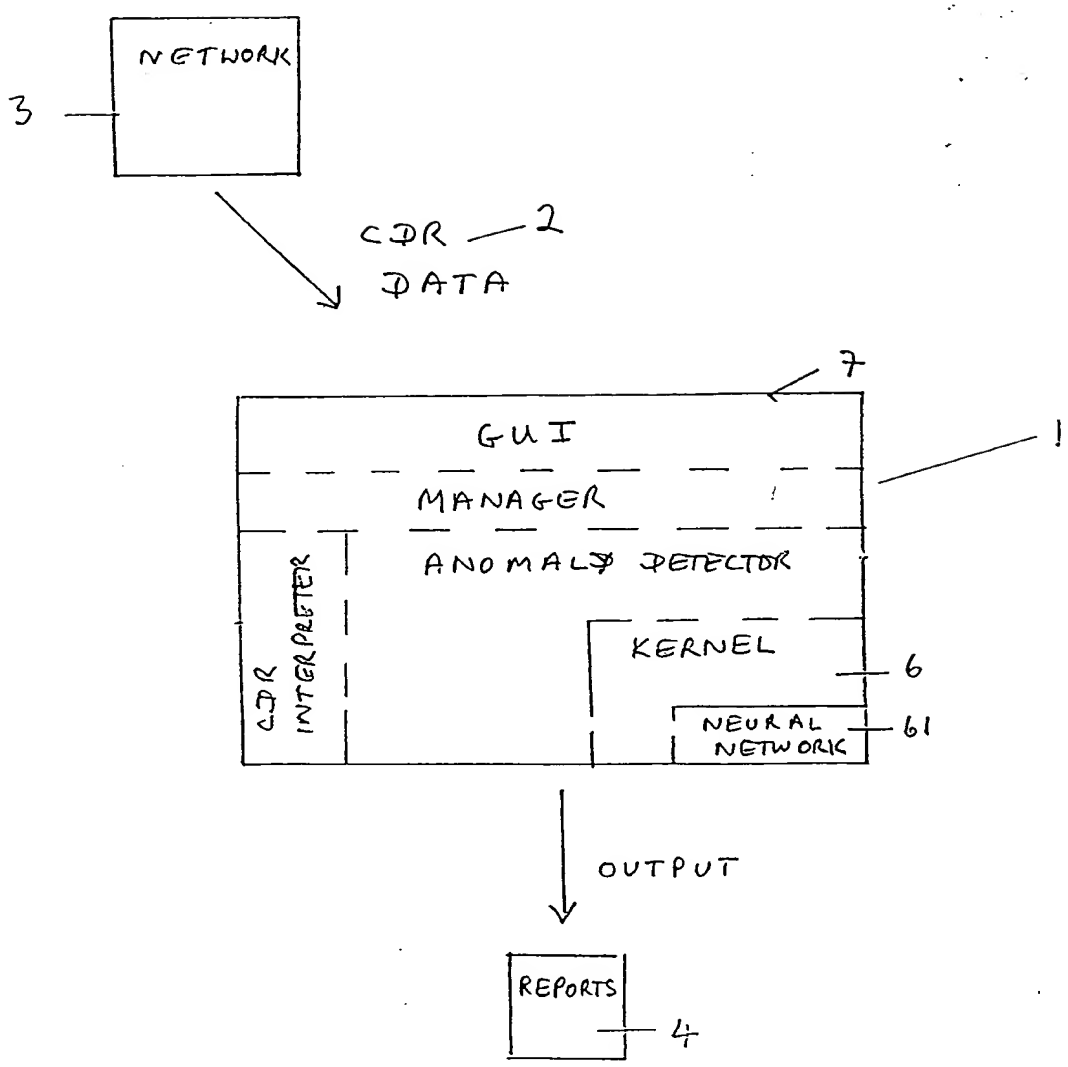

FIGURE 1

US 6,704,874 B1

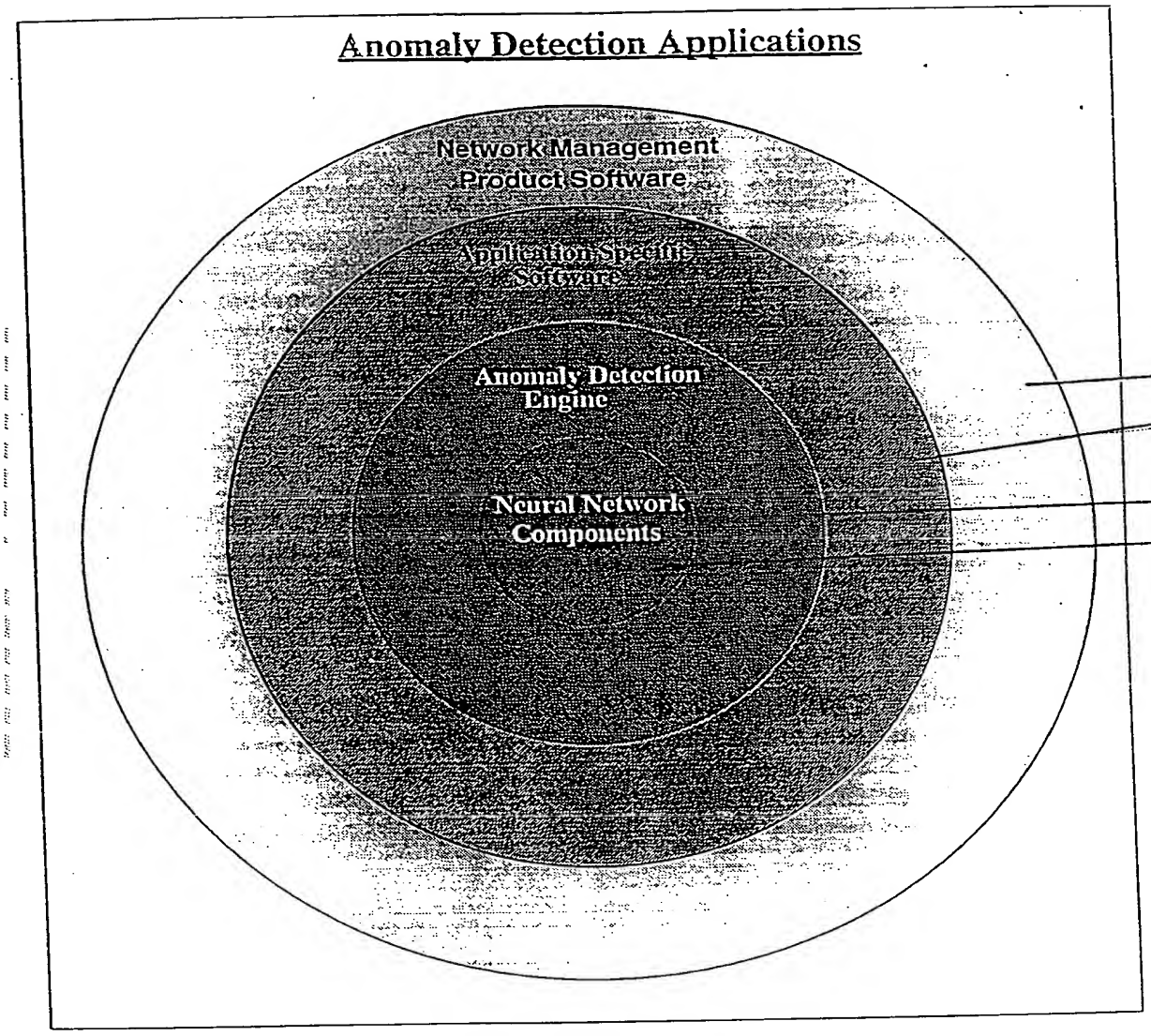
Anomaly Detection Applications
Network Management Product Software
Application Specific Software
Anomaly Detection Engine
Neural Network Components
23
22
20
21

FIGURE 2.

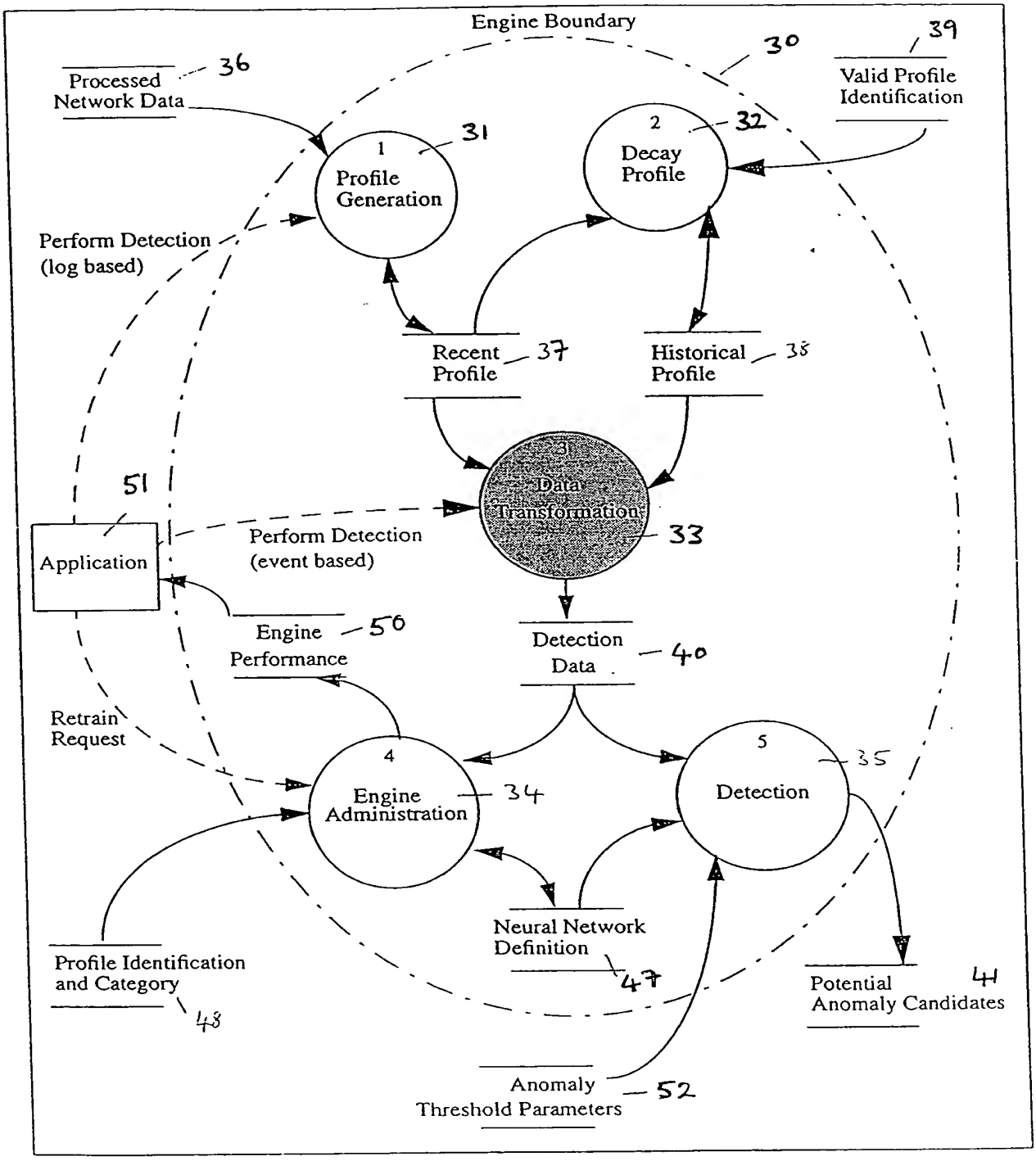
Engine Boundary
30
Processed Network Data
36
Valid Profile Identification
39
1
Profile Generation
31
2
Decay Profile
32
Perform Detection (log based)
Recent Profile
37
Historical Profile
38
3
Data Transformation
33
51
Application
Perform Detection (event based)
Engine Performance
50
Detection Data
40
Retrain Request
4
Engine Administration
34
5
Detection
35
Neural Network Definition
47
Profile Identification and Category
48
Potential Anomaly Candidates
41
Anomaly Threshold Parameters
52

FIGURE 3

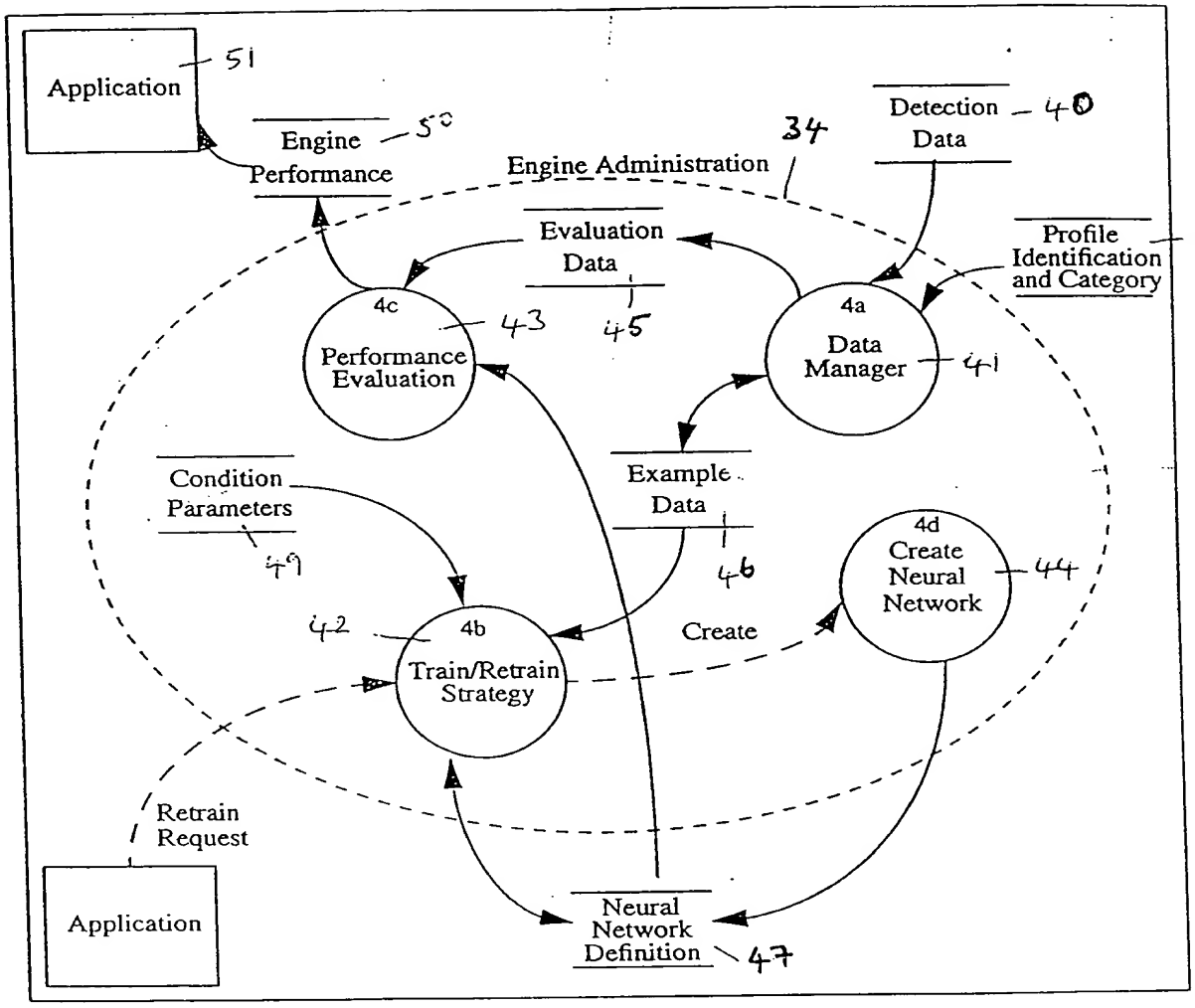
Application
51
Engine Performance
50
Engine Administration
34
Detection Data
40
Evaluation Data
45
Profile Identification and Category
48
4c
Performance Evaluation
43
4a
Data Manager
41
Condition Parameters
49
Example Data
46
4d
Create Neural Network
44
42
4b
Train/Retrain Strategy
Create
Retrain Request
Application
Neural Network Definition
47

FIGURE 4

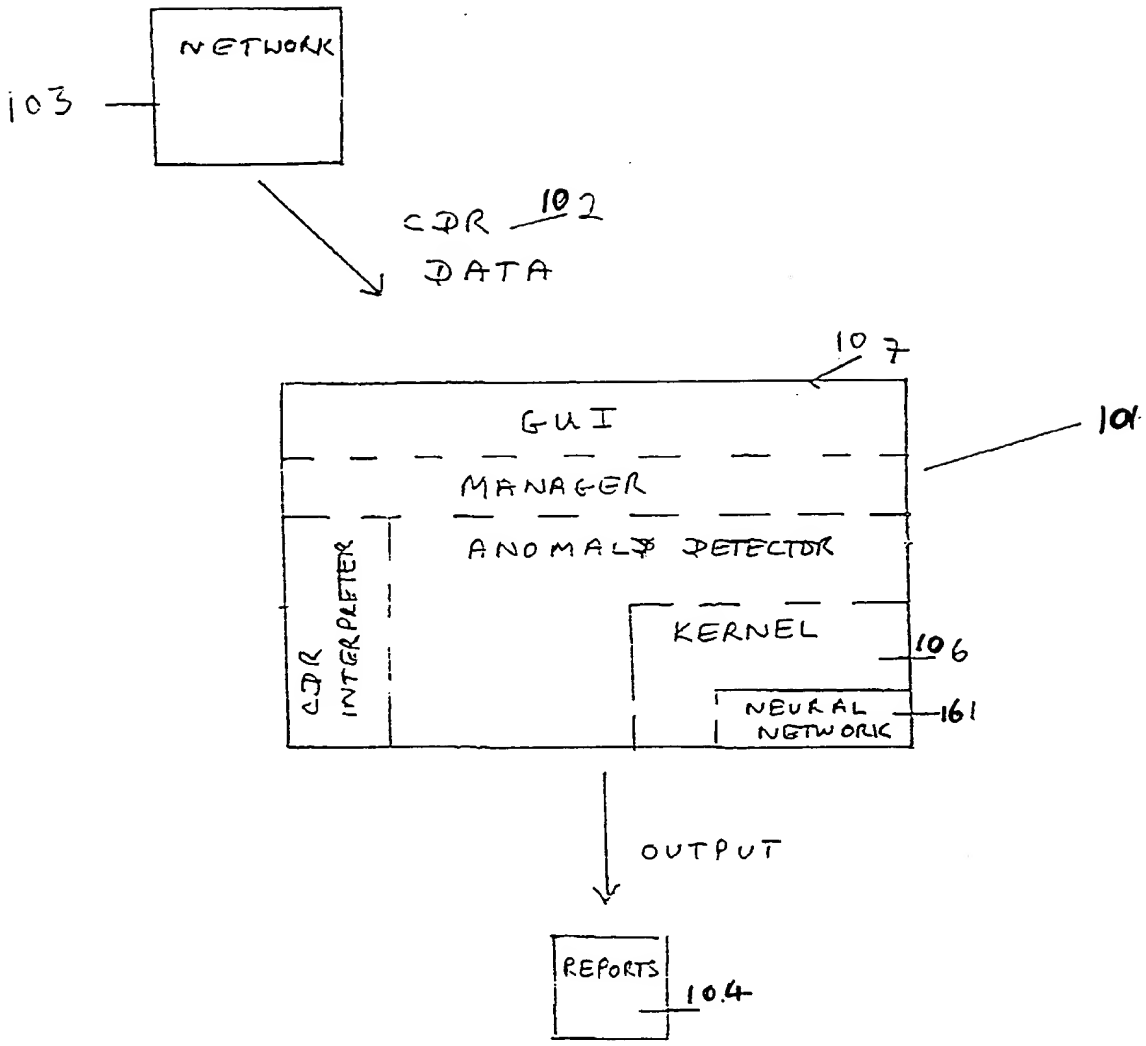
NETWORK
103
CDR DATA
102
107
GUI
MANAGER
ANOMALY DETECTOR
CDR INTERPRETER
KERNEL
106
NEURAL NETWORK
161
101
OUTPUT
REPORTS
104

FIGURE 5

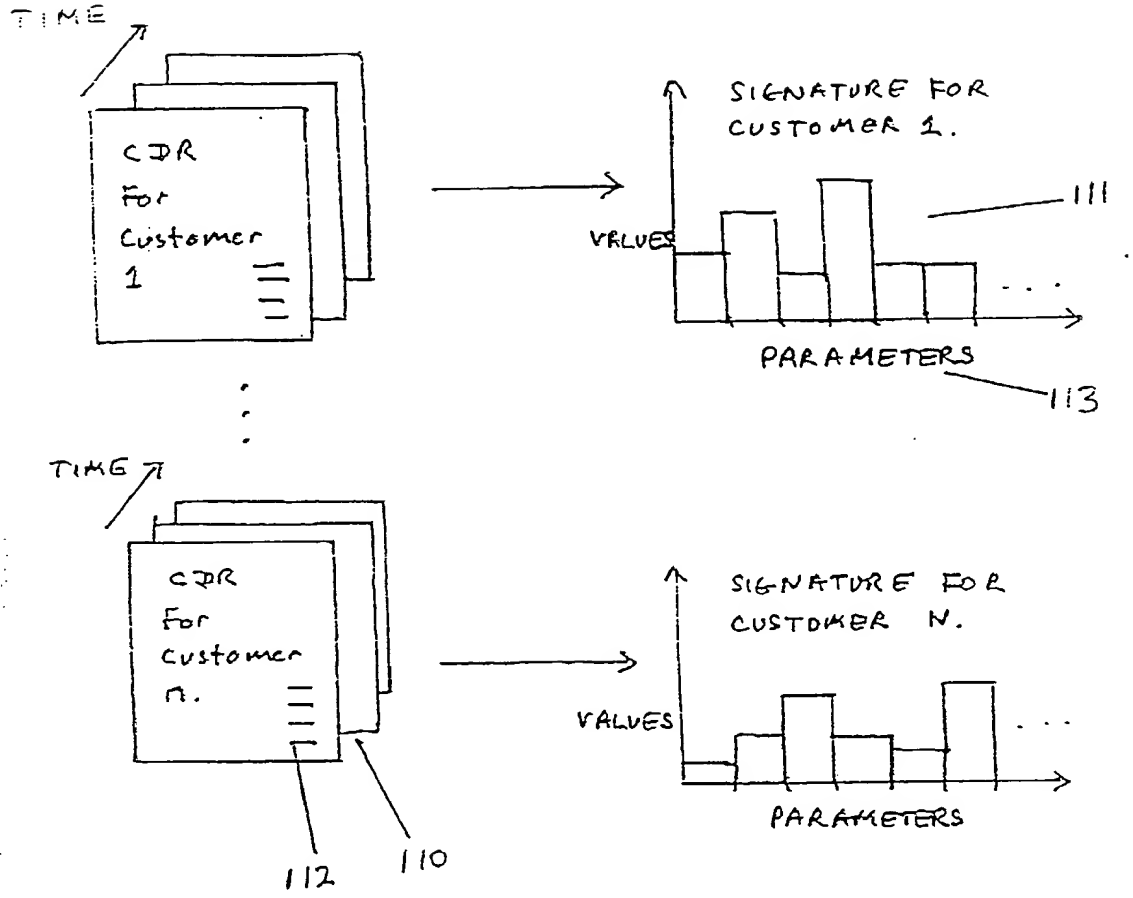

FIGURE 6

2600-1000-0000

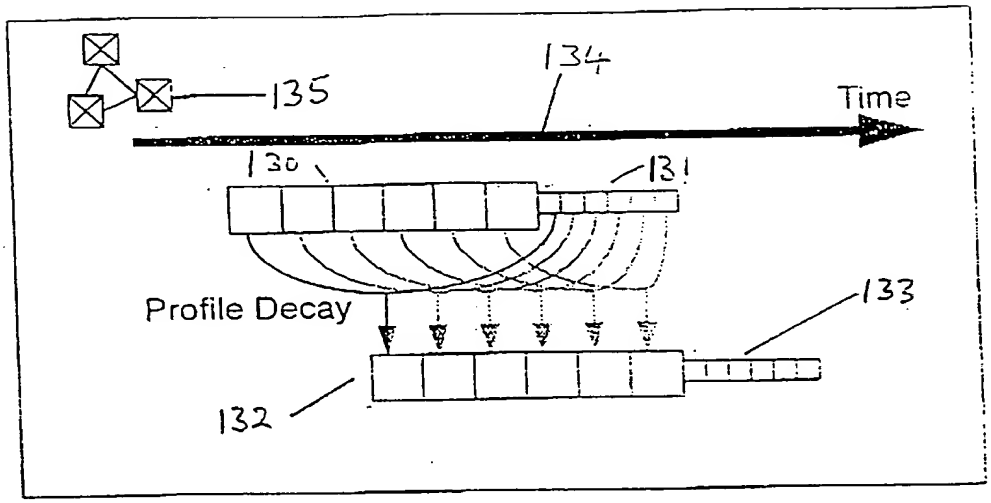

FIGURE 7

SUBSTITUTE SHEET (RULE 26)

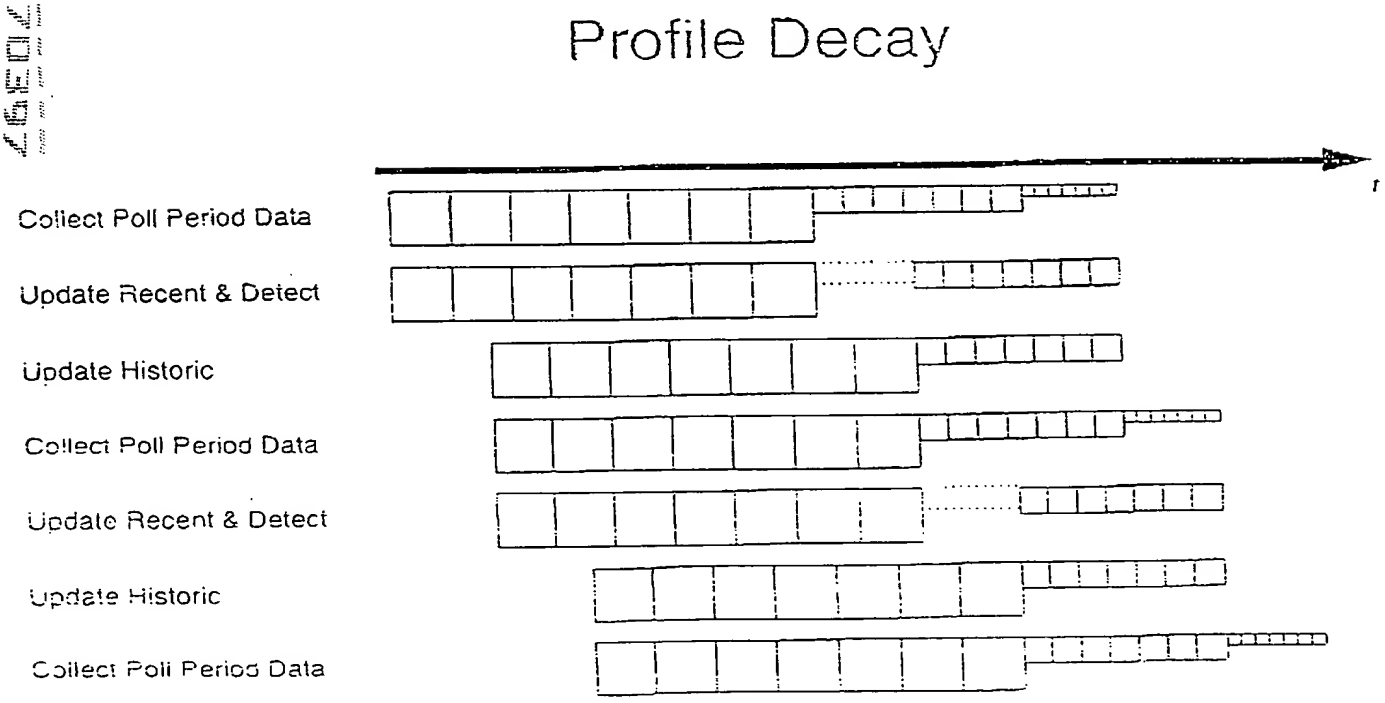

FIGURE 8

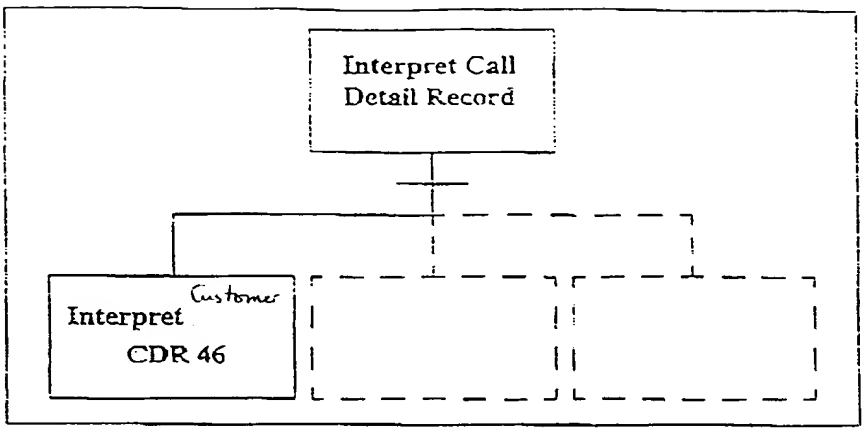

FIGURE 9

Element Name	Position (From 0)	Format
CALL_START_DT	9	YYYY-MM-DD HH:MM:SS.ss
LONG_DUR_CALL_IND	12	1— First 6 hours 2 — Middle 3 — Completed
SERVICE_FEATURE_CODE	15	00 — Other 10 — Three way calling 12 — Call forwarding 14 — Call forward busy
ORIG_TELNO	16	CHAR(24)
CALL_DURATION	20	MMMMSS
ORIG_NNG	22	DDDD
DEST_NNG	23	DDDD
DAY_OF_WEEK	24	1-7 (Mon=1, Sun=7)

FIGURE 10

Attribute name	Type
AccountNumber	String
CallForward	Boolean
LongCall	Boolean
Duration	Integer
Destination	Enum {Local, National, International}
171 DayOfWeek	Enum {Monday, Tuesday, ..., Sunday}
172 CallTime	Time

FIGURE 11

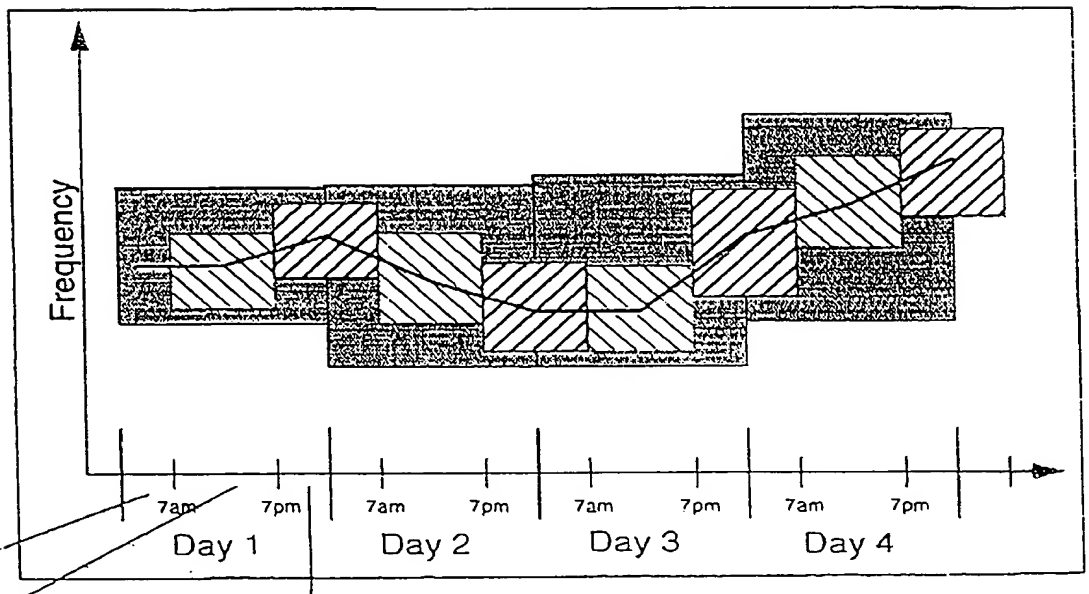

FIGURE 13

Profile Field No.	Attribute	Coverage Time Period	Type	Range
1	% Local		float	0.00—1.00
2	% National		float	0.00—1.00
3	% International		float	0.00—1.00
4	Total Number of Calls		float	N/A
5	Average Duration		float (number of seconds)	N/A
6	Number of Long Calls		float	N/A
7	No. of Call Forwards		float	N/A
8	% Monday	00:00:00—23:59:59	float	0.00—1.00
9	% Tuesday	00:00:00—23:59:59	float	0.00—1.00
10	% Wednesday	00:00:00—23:59:59	float	0.00—1.00
11	% Thursday	00:00:00—23:59:59	float	0.00—1.00
12	% Friday	00:00:00—23:59:59	float	0.00—1.00
13	% Saturday	00:00:00—23:59:59	float	0.00—1.00
14	% Sunday	00:00:00—23:59:59	float	0.00—1.00
15	% 7am -> 7pm Monday	07:00:01—19:00:00	float	0.00—1.00
16	% 7pm Monday -> 7am Tuesday	19:00:01—07:00:00	float	0.00—1.00
17	% 7am -> 7pm Tuesday	07:00:01—19:00:00	float	0.00—1.00
18	% 7pm Tuesday -> 7am Wednesday	19:00:01—07:00:00	float	0.00—1.00
19	% 7am -> 7pm Wednesday	07:00:01—19:00:00	float	0.00—1.00
20	% 7pm Wednesday -> 7am Thursday	19:00:01—07:00:00	float	0.00—1.00
21	% 7am -> 7pm Thursday	07:00:01—19:00:00	float	0.00—1.00
22	% 7pm Thursday -> 7am Friday	19:00:01—07:00:00	float	0.00—1.00
23	% 7am -> 7pm Friday	07:00:01—19:00:00	float	0.00—1.00
24	% 7pm Friday -> 7am Saturday	19:00:01—07:00:00	float	0.00—1.00
25	% 7am -> 7pm Saturday	07:00:01—19:00:00	float	0.00—1.00
26	% 7pm Monday -> 7am Sunday	19:00:01—07:00:00	float	0.00—1.00
27	% 7am -> 7pm Sunday	07:00:01—19:00:00	float	0.00—1.00
28	% 7pm Monday -> 7am Monday	19:00:01—07:00:00	float	0.00—1.00

FIGURE 12

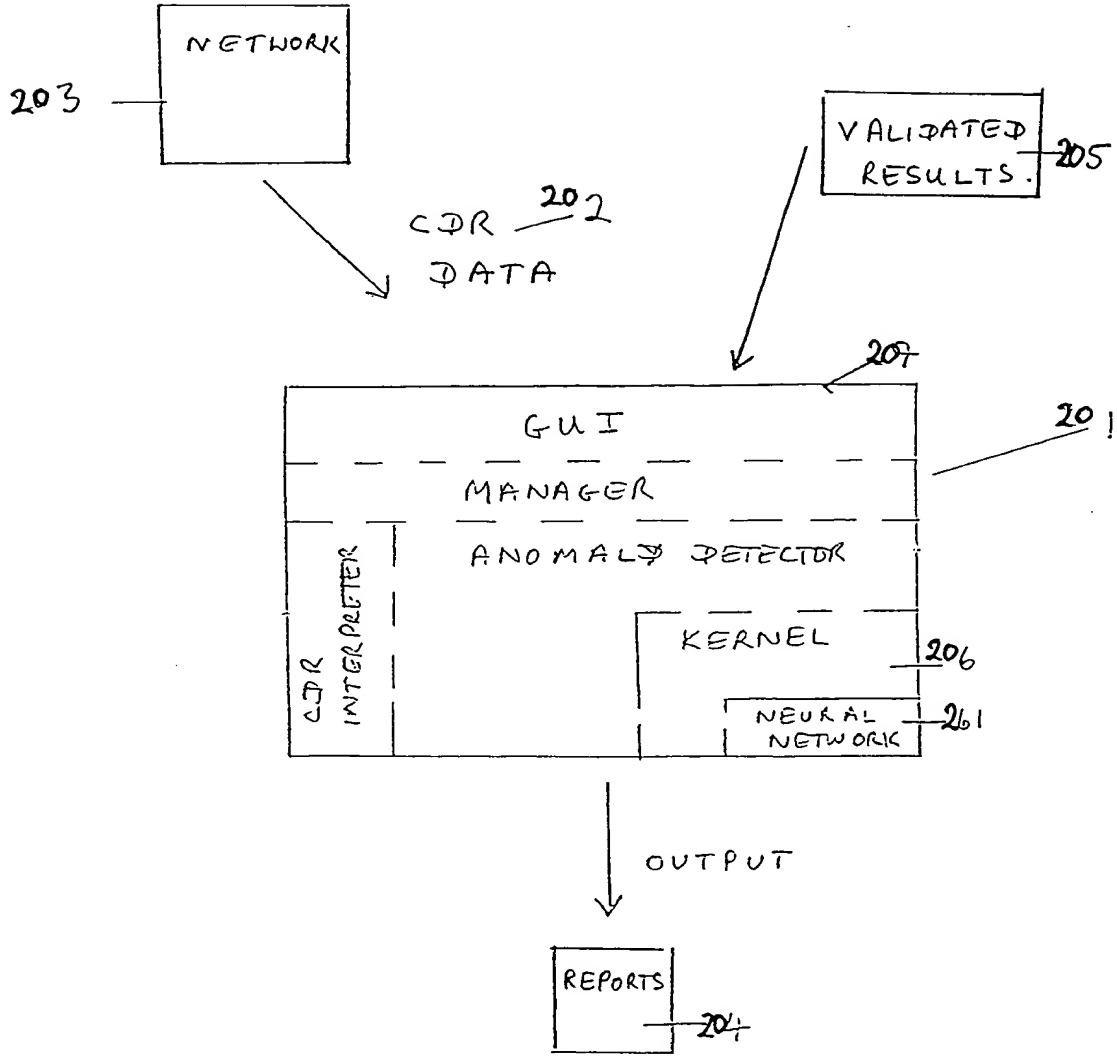
NETWORK
203
VALIDATED RESULTS.
205
CDR DATA
202
207
GUI
MANAGER
ANOMALY DETECTOR
201
CDR INTERPRETER
KERNEL
206
NEURAL NETWORK
261
OUTPUT
REPORTS
204

FIGURE 14

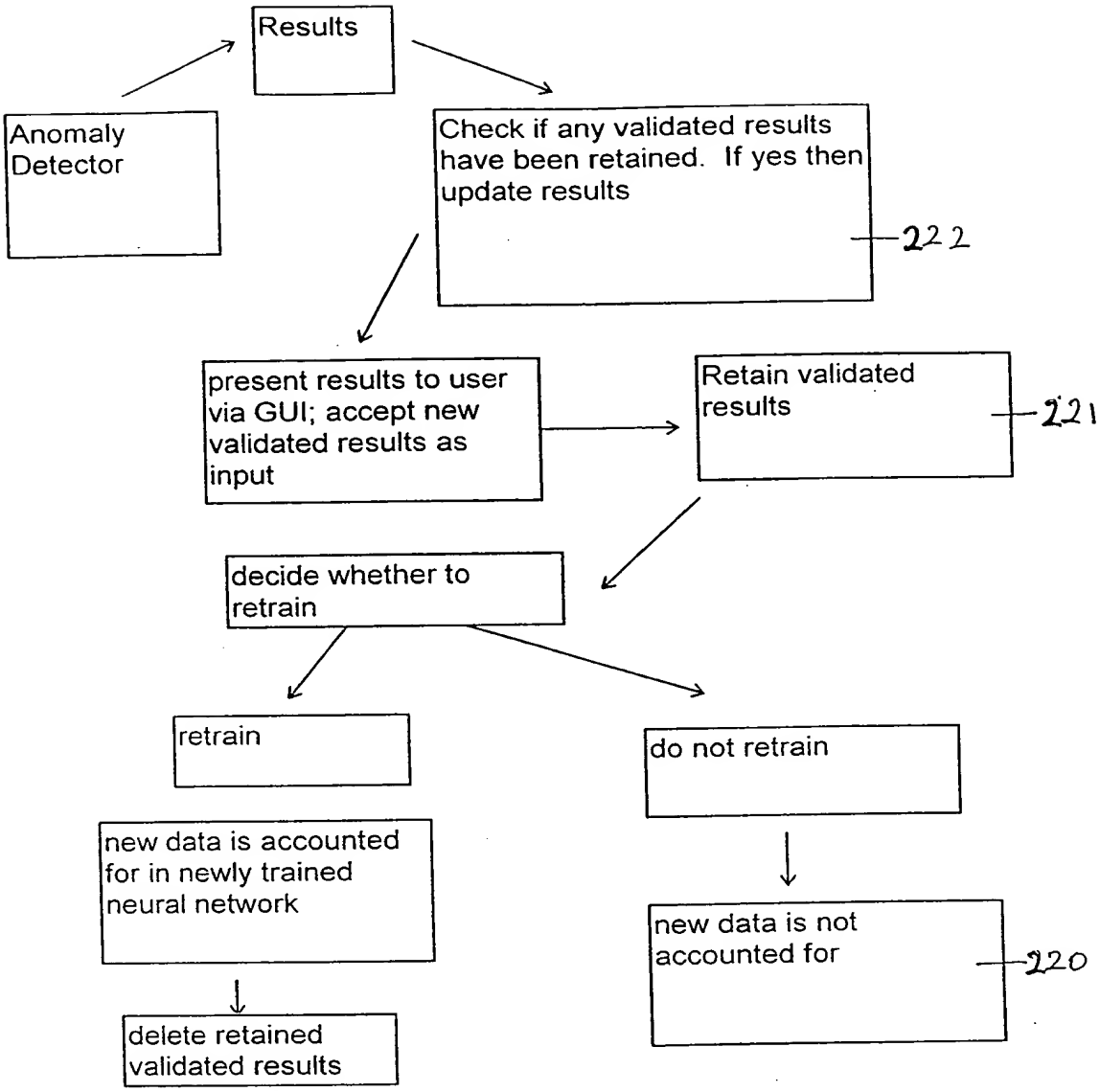
Results
Anomaly Detector
Check if any validated results have been retained. If yes then update results
222
present results to user via GUI; accept new validated results as input
Retain validated results
221
decide whether to retrain
retrain
new data is accounted for in newly trained neural network
delete retained validated results
do not retrain
new data is not accounted for
220

FIGURE 15

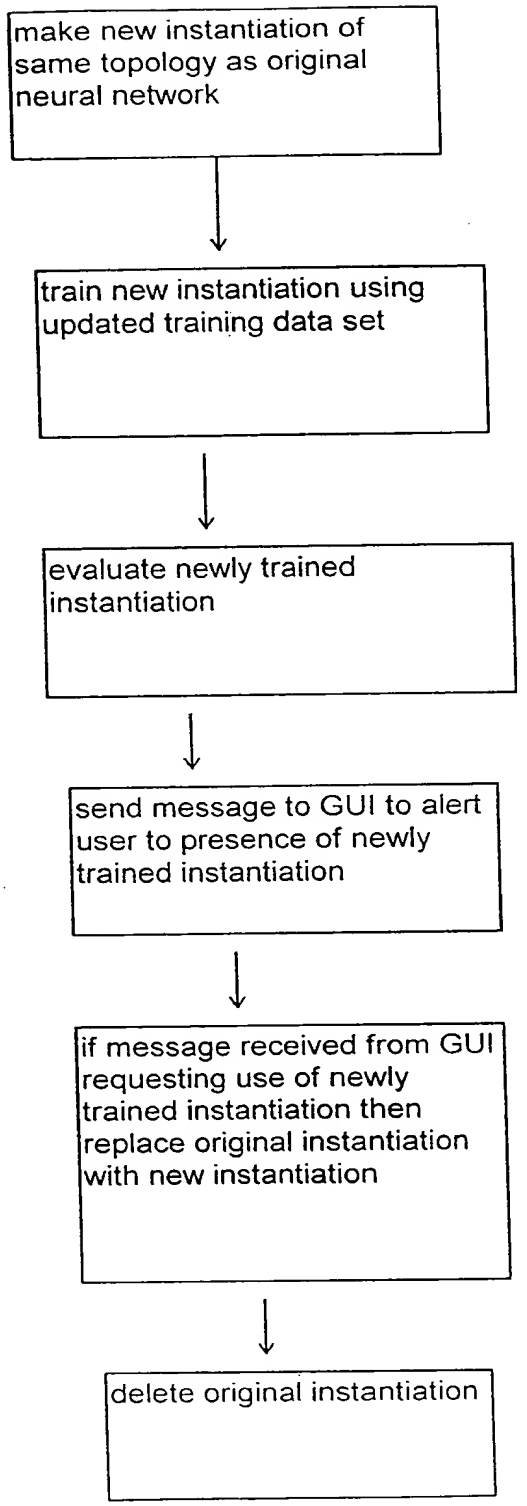
make new instantiation of same topology as original neural network
train new instantiation using updated training data set
evaluate newly trained instantiation
send message to GUI to alert user to presence of newly trained instantiation
if message received from GUI requesting use of newly trained instantiation then replace original instantiation with new instantiation
delete original instantiation

FIGURE 16

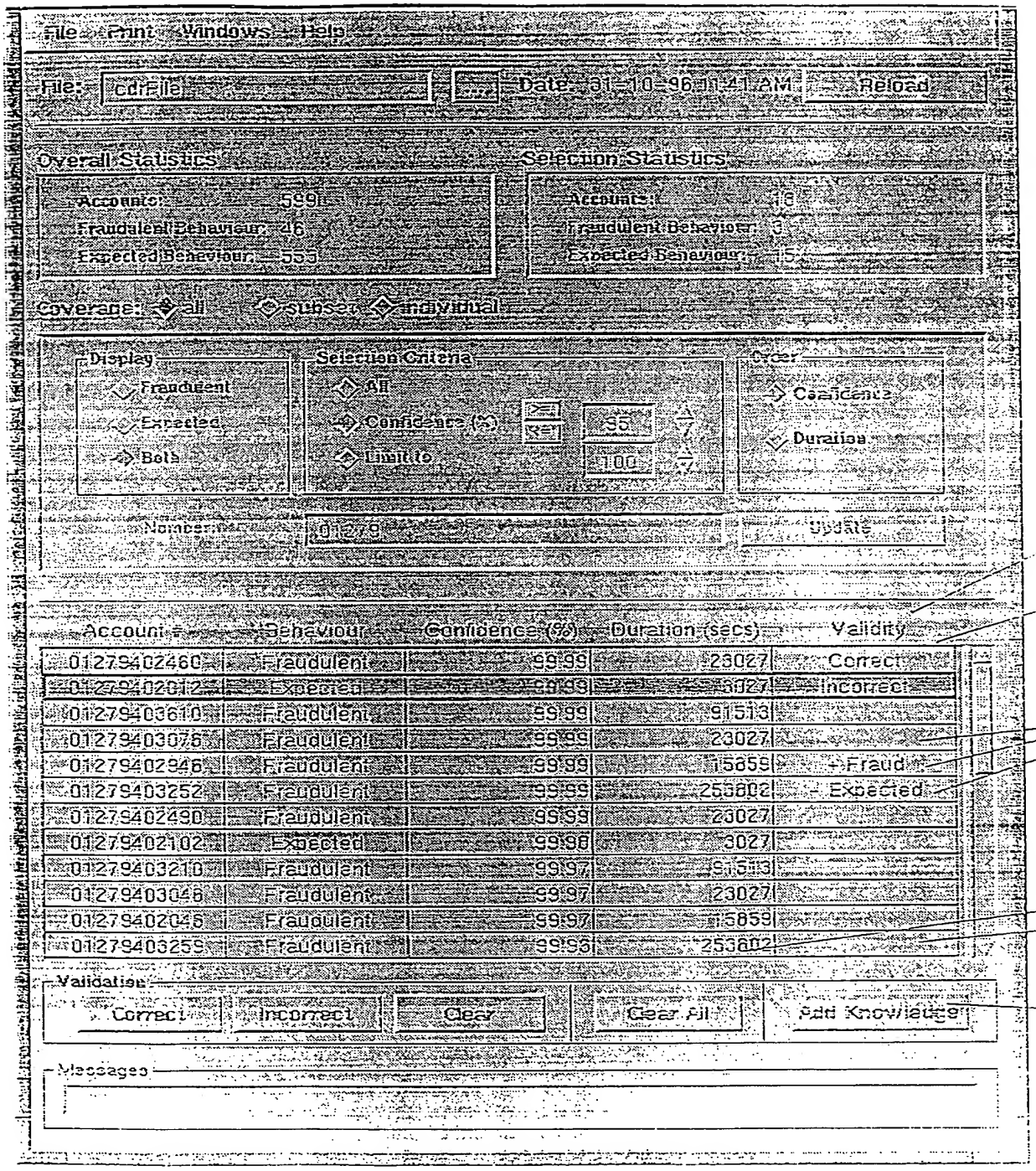
File Print Windows Help
File: cdrFile
Date: 31-10-96 11:41 AM
Reload
Overall Statistics
Accounts: 599
Fraudulent Behaviour: 46
Expected Behaviour: 553
Selection Statistics
Accounts: 18
Fraudulent Behaviour: 3
Expected Behaviour: 15
Coverage: all subset individual
Display
Fraudulent
Expected
Both
Selection Criteria
All
Confidence (%)
Limit to
85
100
Order
Confidence
Duration
Number:
01279
Update
Account
Behaviour
Confidence (%)
Duration (secs)
Validity
0127940246 Fraudulent 99.99 23027 Correct
0127940201 Expected 50.00 3027 Incorrect
0127940361 Fraudulent 99.99 91513
0127940307 Fraudulent 99.99 23027
0127940294 Fraudulent 99.99 15859 Fraud
0127940325 Fraudulent 99.99 253802 Expected
0127940249 Fraudulent 99.99 23027
0127940210 Expected 99.98 3027
0127940321 Fraudulent 99.97 91513
0127940304 Fraudulent 99.97 23027
0127940204 Fraudulent 99.97 15859
0127940325 Fraudulent 99.96 253802
Validation
Correct
Incorrect
Clear
Clear All
Add Knowledge
Messages
243
240
241
242
244

FIGURE 17

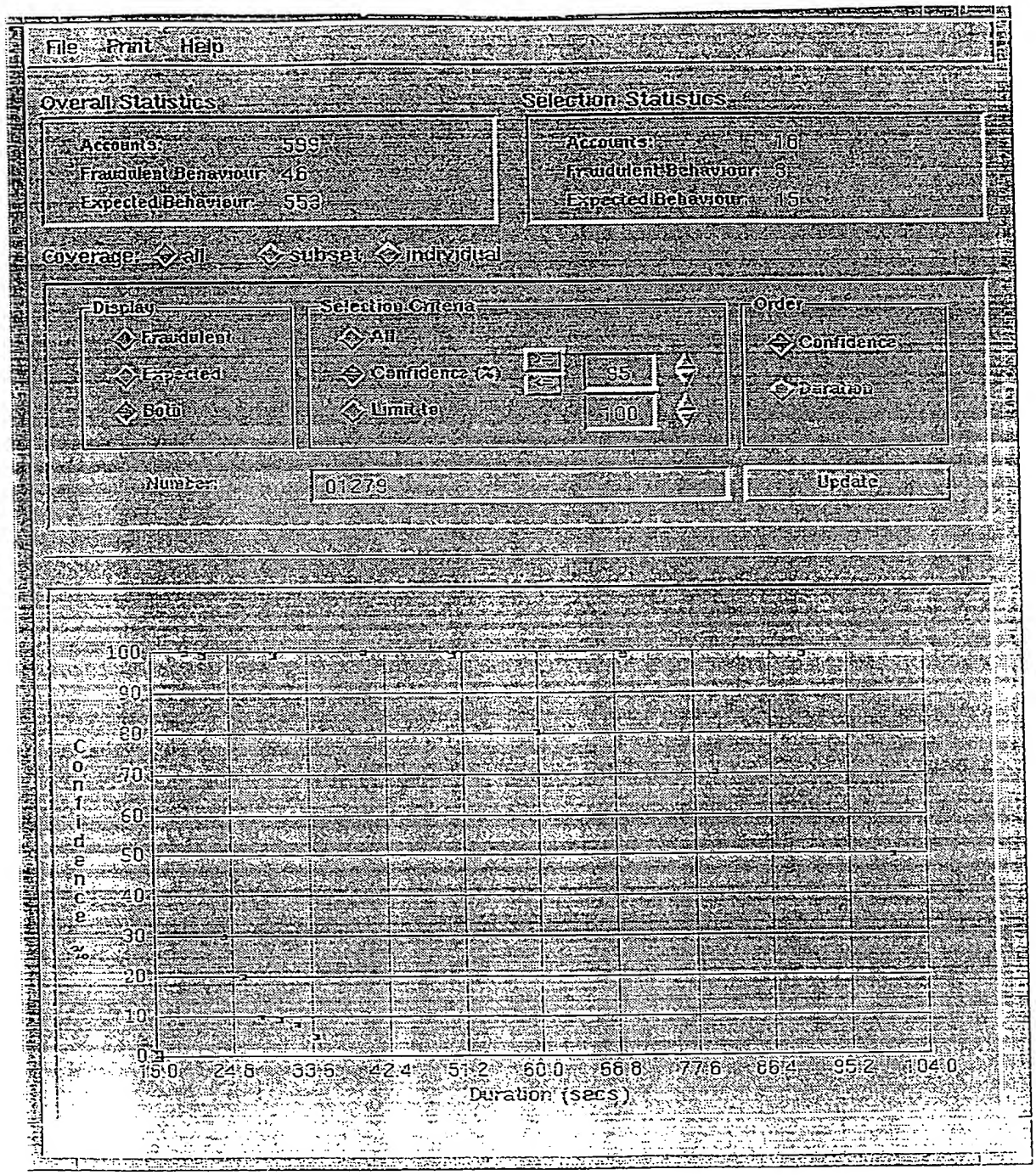
File Print Help
Overall Statistics
Accounts: 599
Fraudulent Behaviour: 46
Expected Behaviour: 553
Selection Statistics
Accounts: 16
Fraudulent Behaviour: 3
Expected Behaviour: 13
Coverage: All Subset Individual
Display
Fraudulent
Expected
Both
Selection Criteria
All
Confidence (%)
Limit to
95
100
Order
Confidence
Duration
Number:
01279
Update
Confidence %
100
90
80
70
60
50
40
30
20
10
0
15.0 24.8 33.5 42.4 51.2 60.0 68.8 77.6 86.4 95.2 104.0
Duration (secs)

FIGURE 18